

## Epigenetics workshop features wide range of cutting-edge research

By Kelly Lenox

Researchers working at the intersection of epigenetics and environmental health sciences came together Jan. 23 for a minisymposium at NIEHS. Participants, who represented a diverse range of work supported by the institute's three research divisions, discussed their latest findings and developed potential collaborations.

"Our goal was two-fold," said Fred Tyson, Ph.D., a program director in the Division of Extramural Research and Training and a co-chair of the NIEHS epigenetics faculty. "We wanted to increase communication across the divisions of NIEHS and to promote collaborative science," he said. Moderators, speakers, and attendees from across the institute and across the country (see [text box](#)) enjoyed a fruitful exchange of ideas and queries, leading Tyson to affirm that the goals were indeed met.

### How cells remember and forget their past

"When we think about epigenetics, we're really thinking about gene memory over time," said Howard Chang, M.D., Ph.D., as he discussed his cutting-edge work on long noncoding RNAs. "What's very mysterious is how a signal causes a gene to stay on after a transient exposure, without the persistent presence of the signal." Chang's research suggests that long noncoding RNA is both a guide and a timer for epigenetic modification. In Chang's words, "RNA helps cells remember and forget their past."

As he concluded, Cheryl Walker, Ph.D., acknowledged the diverse interests of the gathered researchers. "That was one of the best talks I've ever heard, and thank you to NIEHS, because I'm not sure I would have been in the room to hear it any other place," she said.

### Across the sexes, across time

Other presentations emphasized that when environmental exposures cause epigenetic modifications, the effects can be far-reaching. Walker's work explores the hypothesis that early life exposures to endocrine-disrupting chemicals can directly modulate the activity of the epigenome, reprogram it, and increase the susceptibility to disease across the lifespan.

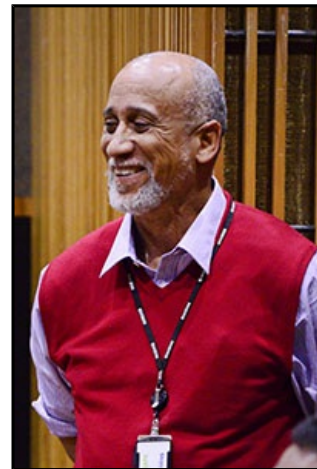
Variables that affect epigenetic modification include not just time, but sex, according to Max Costa, Ph.D., who discussed the effects of arsenic and nickel exposures. "There's a huge difference between the sexes in the effects of arsenic on gene expression," he said.

Diana Laird, Ph.D., pointed out that the field of transgenic epigenetic inheritance calls for new language. For the first time, Laird shared the data emerging from her research on germ cells. She distinguished between multigenerational exposures, in which both an adult female and the eggs she carries might be affected, and transgenerational exposures, in which exposure of a pregnant female affects the germ cells of a fetus, thus affecting the granddaughter generation.

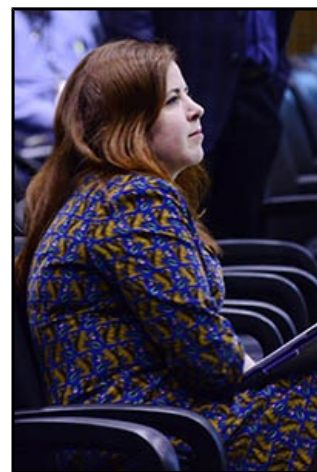
According to Laird, such alteration of germ cell lines has been seen from exposure to several endocrine-disrupting chemicals. Laird was a 2010 recipient of the National Institutes of Health (NIH) [New Innovator Award](#) (<http://commonfund.nih.gov/newinnovator/faq>), which is awarded to support highly innovative approaches to major contemporary challenges in biomedical research.

### Across the spectrum

A variety of techniques and lines of inquiry characterized the day, from the NIEHS Division of the National Toxicology Program (NTP) systematic review of epigenetic studies, described by Katie Pelch, Ph.D., to the talk by Guang Hu, Ph.D., on the INO80 chromatin remodeling complex and its role in regulating the pluripotency of embryonic stem cells, that is, their ability to differentiate into a variety of tissue types.



*Tyson was lead organizer of the minisymposium. He is a program director of the NIH Roadmap Epigenomics Program and oversees a portfolio of grants for the NIEHS Division of Extramural Research and Training, many of which focus on environmental genetics. (Photo courtesy of Steve McCaw)*



*Lisa Chadwick, Ph.D., moderated the morning session. She is also a program director of the NIH Roadmap Epigenomics Program. (Photo courtesy of Steve McCaw)*

In closing comments, John Bucher, Ph.D., associate director of DNTP, noted NIH's interest in increasing in-house researcher and grantee interactions. "Epigenetics is an area that is coming together and showing a great synergy because of this interaction," he said. "This is a terrific example for the other institutes at NIH to follow."

Bill Schrader, Ph.D., NIEHS deputy scientific director, framed his closing comments in the context of the evolving nature of the epigenetics field. "Having the techniques available allows the really complicated questions to be asked," he said, ending with a challenge to the participants. "Always be thinking how you can push the envelope for better tools."

### **NIEHS Cross-divisional Minisymposium on Epigenetics**

#### **Moderators:**

[Lisa Chadwick, Ph.D.](#), NIEHS Division of Extramural Research and Training

[Trevor Archer, Ph.D.](#), NIEHS Epigenetics & Stem Cell Biology Laboratory

#### **Presenters:**

[Howard Chang, M.D., Ph.D.](#)

(<http://changlab.stanford.edu>)

, Stanford University School of Medicine — "Genome Regulation by Long Noncoding RNAs"

[Max Costa, Ph.D.](#)

(<http://www.med.nyu.edu/biosketch/costamo1>)

., New York University Langone Medical Center — "Arsenic Carcinogenesis and Interference With Histone mRNA Processing"

[Guang Hu, Ph.D.](#), NIEHS Epigenetics & Stem Cell Biology Laboratory — "INO80-dependent Chromatin Remodeling in ESC Self-renewal and Pluripotency"

[Diana Laird, Ph.D.](#)

(<http://obgyn.ucsf.edu/crs/faculty/lairdbio.aspx>)

, University of California, San Francisco School of Medicine — "Germ Cell Development and Transgenerational Inheritance in Mice"

[Katherine Pelch, Ph.D.](#), NTP Office of Health Assessment and Translation — "Environmental Influences on the Epigenome: Using SWIFT Text Mining Tool to Assess the Current State of the Science"

[Brian Strahlhm, Ph.D.](#)

(<http://www.med.unc.edu/biochem/strahl>)

, University of North Carolina School of Medicine — "Chromatin Mechanisms That Underlie DNA Methylation Inheritance"

[Paul Wade, Ph.D.](#), NIEHS Epigenetics & Stem Cell Biology Laboratory — "Transgenerational Inheritance of DNA Methylation in the Mouse"

[Cheryl Walker, Ph.D.](#)

(<http://www.ibt.tamhsc.edu/faculty/walker-bio.html>)

, Texas A&M Health Science Center — "Developmental (Re)Programming: Cross-talk Between Environmental Exposures and the Epigenome"



1/6

*Rick Woychik, Ph.D., is the deputy director of NIEHS and also heads the NIEHS Mammalian Genome Group. (Photo courtesy of Steve McCaw)*



2/6

*Walker spoke of enjoying her visit to NIEHS, where she was a research fellow in the 1980s. (Photo courtesy of Steve McCaw)*



3/6

*Trevor Archer, Ph.D., left, head of the NIEHS Chromatin and Gene Expression Group and moderator of the afternoon session, shared a light moment with grantee Walker, right. (Photo courtesy of Steve McCaw)*



4/6

*NIEHS Eukaryotic Transcriptional Regulation Group head Paul Wade, Ph.D., like the other presenters, was active in the question and answer sessions that sparked lively exchanges among the scientists. Wade co-chairs the epigenetics faculty with Tyson. (Photo courtesy of Steve McCaw)*



5/6

*"An invisible hand keeping a gene in an on or off state is the mechanism behind epigenetics and the concept of gene memory over time," said Chang. (Photo courtesy of Steve McCaw)*



6/6

*Raymond Tice, Ph.D., former head of the NIEHS Biomolecular Screening Branch, attended the full day meeting despite his impending retirement. (Photo courtesy of Steve McCaw)*

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